Declaration

I, the undersigned, Keiko Naoi, residing at 1-22-19, Shonan Village, Yokosuka-shi, Kanagawa, JAPAN 240-0107, do solemnly and sincerely declare that I well understand the Japanese Language and the English language and that the attached English translation of a certified copy of Japanese Patent Application No.2000-298157 is true, correct, and faithful translation to the best of my knowledge and belief from the Japanese language into the English language.

Dated this 20th day of June, 2001

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[Name of Document] SPECIFICATION

[Title of the Invention] SEATBELT RETRACTOR

[Claims]

[Claim 1] A seatbelt retractor at least comprising:

a reel for winding the webbing;

a locking mechanism having a locking member that is prevented from rotating in the webbing unwinding direction in case of emergency;

a torsion bar provided concentrically with said reel and rotatably connecting between said reel and said locking member for restraining a load applied to said webbing when rotation of said locking member in the webbing unwinding direction is prevented to allow said reel to rotate in the webbing unwinding direction with respect to said locking member by a prescribed amount; and

said torsion bar comprising a first torque transmitting shaft to be press-fitted into the axial hole on said reel and the second torque transmitting shaft press-fitted into the axial hole on said locking member,

characterized in that a backlash preventing portion for preventing backlash in the press-fitted state of at least one of said first torque transmitting shaft and said second torque transmitting shaft is provided on at least one of said first torque transmitting shaft and said second torque transmitting shaft or at least one of the inner peripheral

surfaces of the respective axial holes on said reel and the same on said locking member at the position where a large force generated when rotation of said locking member in the webbing unwinding direction is locked is not applied.

[Claim 2] A seatbelt retractor as set forth in Claim 1, characterized in that said backlash preventing portion is a backlash preventing rib provided on at least one of said first torque transmitting shaft and said second torque transmitting shaft or on at least one of the inner peripheral surfaces of the respective axial holes on said reel and the same on said locking member so as to extend in the axial direction.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a technical field of a seatbelt retractor that winds the webbing so as to be capable of winding and unwinding, and more specifically, to a technical field of a seatbelt retractor comprising a load restricting mechanism (EA mechanism) that restrains a load applied to the webbing by a torsion bar when the unwinding of the seatbelt is prevented in case of emergency such as a crash in which a large extent of deceleration of the vehicle is affected with the webbing fastened.

[0002]

[Description of the Related Art]

Hitherto, the seatbelt apparatus mounted on the vehicle such as automotive vehicles prevents jumping out of the passenger from the seat and thus protects the passenger by restraining the passenger with webbing in case of emergency described above.

Such a seatbelt apparatus is provided with a seatbelt retractor for winding the webbing. In the seatbelt retractor, the webbing is wound on the reel when it is not used, but pulled out and fastened on the passenger when it is used. In the seatbelt retractor, the locking mechanism is actuated in case of emergency as described above to prevent rotation of the reel in the unwinding direction, and thus unwinding of the webbing is prevented. Therefore, the passenger is positively restrained and protected in case of emergency.

[0003]

Incidentally, in the seatbelt retractor of the conventional seatbelt apparatus, when the webbing restrains and protects the passenger in case of emergency such as a crash of the vehicle, a large extent of deceleration of the vehicle occurs and thus the passenger is apt to move forward by large inertia. Therefore, the webbing is applied with a large load and the passenger is applied with a large impact from the webbing. Though the large impact is a minor matter

for the passenger, it is preferable to be restrained if it is possible.

[0004]

Therefore, various seatbelt retractors comprising an EA mechanism for restraining a load applied to the webbing by a torsion bar in case of emergency with the webbing fastened has been conventionally proposed.

In the seatbelt retractor comprising an EA mechanism, the reel for winding the webbing and the locking base of the locking mechanism for locking the rotation of the reel in the webbing unwinding direction in case of emergency are rotatably (so as to be capable of transmitting a torque) connected by a torsion bar. When the locking mechanism is actuated in case of emergency, rotation of the locking base in the webbing unwinding direction is prevented, but the torsion bar is twisted because unwinding of the webbing due to inertia of the passenger makes the reel rotate in the webbing unwinding direction. Subsequently, the reel rotates in the webbing unwinding direction while twisting the torsion bar, and a load applied to the webbing by a torsional torque of the torsion bar is restricted and thus the impact applied to the passenger is absorbed and alleviated.

[0005]

When the torsion bar is rotatably connected to the reel

and the locking base, axial hole of hexagonal cross section are respectively formed at the center positions of the reel and the locking base, and torque transmitting shafts of hexagonal cross section are respectively provided on the torsion bar at the position where the reel and the locking base are rotationally connected, so that the torque transmitting shaft are press-fitted into the axial holes on the reel and the locking base. In this case, in order to prevent backlash at the time of press-fitting, three backlash preventing ribs *i*, *j*, *k* are conventionally provided respectively at the centers of the three sides *c*, *e*, *g*, which are not adjacent, out of six arc-shaped sides *c*, *d*, *e*, *f*, *g*, and *h* of the axial hole *b* having a hexagonal cross section formed on the reel *a* as shown in Fig. 7, for example, to fix and support the torsion bar *m*. Likewise, three backlash preventing ribs are also formed on the center positions of three arc-shaped sides of the axial hole having hexagonal cross section formed on the locking base, though it is not shown.

[0006]

[Problems to be Solved by the Invention]

However, providing backlash preventing ribs *i*, *j*, *k* at the center positions of the sides *c*, *e*, *g* of the hexagonal cross section of the axial hole *b* as in the conventional case has a following problem. That is, when a load is

applied to the webbing at the time when the lock of the locking mechanism is actuated and the webbing is being unwound, the reel *a* is apt to rotate in the webbing unwinding direction CW as shown in Fig. 7, and a large force to rotate the torsion bar *m* is applied from the reel *a* to the torsion bar *m*. At this time, since the large force is applied to the torsion bar m via the backlash preventing ribs *i*, *j*, *k* at the center positions of sides *c*, *e*, *g* of the axial hole *b*, the backlash preventing ribs *i*, *j*, *k* are collapsed and thus a gap is generated between the reel and the torsion bar. Such a gap between the reel *b* and the torsion bar *m* causes backlash and thus contributes to generate squeak and rattle. Likewise, a gap is also generated between the torsion bar *m* and the locking base.

[0007]

With such circumstanced in view, it is an object of the present invention to provide a seatbelt retractor that can positively prevent backlash between the torsion bar and the member in which the same is fitted even when a large force is applied to the torsion bar when the lock of the locking mechanism is actuated.

[0008]

[Means for Solving the Problems]

In order to solve the problem described above, the invention according to Claim 1 is a seatbelt retractor at

least comprising a reel for winding the webbing, a locking mechanism having a locking member that is prevented from rotating in the webbing unwinding direction in case of emergency, and a torsion bar provided concentrically with the reel and rotatably connecting between the reel and the locking member for restraining a load applied to the webbing when rotation of the locking member in the webbing unwinding direction is prevented to allow the reel to rotate in the webbing unwinding direction with respect to the locking member by a prescribed amount, the torsion bar comprising a first torque transmitting shaft to be press-fitted into the axial hole on the reel and the second torque transmitting shaft press-fitted into the axial hole on the locking member, characterized in that a backlash preventing portion for preventing backlash in the press-fitted state of at least one of the first torque transmitting shaft and the second torque transmitting shaft is provided on at least one of the first torque transmitting shaft and the second torque transmitting shaft or at least one of the inner peripheral surfaces of the axial holes on the reel and the same on the locking member at the position where a large force generated when rotation of the locking member in the webbing unwinding direction is locked is not applied.

The invention according to Claim 2 is characterized in that the backlash preventing portion is a backlash

preventing rib provided on at least one of the first torque transmitting shaft and the second torque transmitting shaft or on at least one of the inner peripheral surfaces of the respective axial holes on the reel and the same on the locking member so as to extend in the axial direction.

[0009]

[Operation]

In the seatbelt retractor of the present invention of such a structure, a backlash preventing portion is provided on at least one of the first torque transmitting shaft and the second torque transmitting shaft or on at least one of the inner surfaces of the respective axial holes on the reel and the same on the rocking member, at the position where a large force generated when rotation of the locking member in the webbing unwinding direction is locked is not applied. Therefore, since a large force generated when rotation of the locking member in the webbing unwinding direction is locked is not applied to the backlash preventing portion, the backlash preventing portion is not collapsed.

Therefore, when rotation of the locking member in the webbing unwinding direction is locked, backlash at least one of the portion between the torsion bar and the reel, and between the torsion bar and the locking member caused by collapse of the backlash prevention portion is prevented and thus squeak and rattle caused by backlash are not generated.

[0010]

[Description of the Embodiments]

Referring now to the drawings, an embodiment of the present invention will be described.

Fig. 1 is a cross sectional view of a seatbelt retractor according to an example of the embodiment of the present invention.

In a first place, as regards the components and the operation of the seatbelt retractor of this example, the reference numerals and signs of the same parts as the components of conventional seatbelt retractor, and the operation that is the same as the conventional seatbelt retractor are briefly described respectively.

[0011]

In Fig. 1, the reference numeral 1 designates a seatbelt retractor, 2 designates an one-side opened rectangular frame, 3 designates webbing, 4 designates a reel rotatably supported between the both side walls of the one-side opened rectangular frame 2 for winding webbing 3, 5 designates a deceleration sensing means actuated by sensing a large deceleration generated in case of emergency described above, 6 designates a locking mechanism actuated by the deceleration sensing means 5 for preventing at least rotation of the reel 4 in the belt unwinding direction, 7 designates a torsion bar axially disposed at the center of

the reel 4 for rotatably connecting the reel 4 and the locking mechanism 6, 8 designates a spring means for urging the reel 4 all the time in the belt winding direction via the bush 10 by a spring force of a spiral spring 9, 11 designates a pretensioner actuated in case of emergency described above for generating a belt winding torque, and 12 designates a bush for transmitting a webbing winding torque of the pretensioner 11 to the reel 4.

[0012]

On both ends of the torsion bar 7, there are formed a second torque transmission shaft 17 to be fitted into the axial hole of the locking base (corresponding to the locking member of the present invention) so as not to be capable of relative rotation, and a first torque transmission shaft 18 to be fitted into the axial hole of the reel 4 so as not to be capable of relative rotation, respectively. Though it is not shown, these first and second torque transmission shafts 18, 17 have hexagonal cross section having arc-shaped sides, and the respective axial holes on the locking base 14 and the reel 4 also have hexagonal cross sections having arc-shaped sides. The first and the second torque transmission shafts 18, 17 of the torsion bar are respectively press-fitted into the respective axial holes of the locking base 14 and the reel 4.

[0013]

In this seatbelt retractor 1, the webbing 3 is completely wound by an urging force of a spring means 8 when the webbing is not fastened. When the webbing 3 is pulled out at the normal speed for fastening the same, the reel 4 rotates in the webbing unwinding direction and thus the webbing 3 is pulled out smoothly. After the tongue slidably provided on the webbing 3, which is not shown, is inserted and locked into the buckle fixed on the vehicle body, the portion of the webbing 3 that is excessively pulled out is wound on the reel 4 by an urging force of the spring means 8, so that the webbing 3 is fitted to the passenger to the extent that the passenger does not have a feeling of pressure.

[0014]

In case of emergency as described above, the webbing winding torque generated by the pretensioner 11 is transmitted to the reel 4, and the reel 4 winds the webbing 3 by a prescribed amount, so that the passenger is fixedly restrained. On the other hand, a large deceleration generated in case of emergency activates deceleration sensing means 5 to induce locking operation of the locking mechanism 6. In other words, the operation of the deceleration sensing means 5 prevents rotation of lock gear 6a in the webbing unwinding direction and rotates the pawl 13 rotatably supported by the locking base 14 of the locking

mechanism 6 to engage the inner tooth 19 of the sidewall of the frame 2. Then, rotation of the locking base 14 in the webbing unwinding direction is prevented, the torsion bar 7 is twisted and only the reel 4 rotates with respect to the locking base 14 in the webbing unwinding direction. Subsequently, the reel 4 rotates in the webbing unwinding direction while twisting the torsion bar 7, and a torsional torque of the torsion bar 7 restricts a load applied to the webbing 3, and thus the impact applied to the passenger is absorbed and alleviated.

[0015]

The seatbelt retractor 1 is constructed in such a manner that the locking base 14 of the locking mechanism 6 rotates with respect to the lock gear 6a in the webbing unwinding direction even when the webbing is abruptly pulled, whereby the pawl 13 of the locking mechanism 6 engages the inner tooth 19 of the side wall of the frame 2 to prevent rotation of the locking base 14 as described above, rotation of the reel 4 in the unwinding direction is prevented by the torsion bar 7, thereby preventing unwinding of the webbing 3.

[0016]

As shown in Fig. 2(a) by a solid line, the reel 4 of the seatbelt retractor 1 of this example is provided with arc-shaped sides $4a_1$, $4a_2$, $4a_3$, $4a_4$, $4a_5$, $4a_6$ forming an inner peripheral surface of the axial hole 4a of hexagonal cross

section, and the inner surface of the three sides $4a_1$, $4a_3$, $4a_5$, which are not adjacent with each other, of the axial hole 4a are formed with three backlash preventing ribs (corresponding to the backlash preventing portion of the present invention) 20, 21, 22 having arc-shaped cross section respectively so as to extend in the axial direction as in the conventional case. However, the positions where these backlash preventing ribs 20, 21, 22 are provided all differ from the conventional case, and the backlash preventing ribs 20, 21, 22 are not provided at the center positions of the respective sides $4a_1$, $4a_3$, $4a_5$. As shown in Fig. 2(b) in an enlarged view, the backlash preventing rib 20, for example, is formed on the side $4a_1$ on the opposite side 4_{a12} from the side $4a_{11}$ to which a large force from the reel 4 to the torsion bar 7 that rotates in the webbing unwinding direction CW for rotating the torsion bar 7 is applied across the center of the side $4a_1$, when a load is applied to the webbing 3 in the case where the lock of the locking mechanism 6 is operated and the webbing is being pulled out. In other words, the backlash preventing rib 20 is provided [on the $4a_{11}$] on the side $4a_{12}$ to which a large force from the reel 4 is not applied. Likewise, two other backlash preventing ribs 21, 22 are provided on the sides of the respective sides $4a_3$, $4a_5$, where a large force is not applied from the reel 4.

[0017]

When three backlash preventing ribs 20, 21, 22 are provided respectively on the respective sides 4a, $4a_3$, $4a_5$ of the axial hole 4a on the sides where a large force is not applied from the reel 4, and when the first torque transmitting shaft 18 of the torsion bar 7 shown by dotted lined in Figs. 2(a) and (b) is press-fitted into the axial hole 4a, the first torque transmitting shaft 18 of the torsion bar 7 is displaced in the direction of rotation and comes to abut against the respective sides $4a_1$-$4a_6$ of the axial hole 4a on the sides to which a large force from the reel 4 is applied by these backlash preventing ribs 20, 21, 22.

[0018]

In the same manner, the same backlash preventing ribs are provided on the three sides of the axial hole on the locking base 14 through which the second torque transmitting shaft 17 of the torsion bar 7 is press-fitted on the side on which a large force from the torsion bar 7 is not applied, though they are not shown in the figure, whereby the second torque transmitting shaft 17 of the torsion bar 7 is displaced in the direction of rotation and abuts against the respective sides of the axial hole of the locking base 14 on the sides to which a large force from the torsion bar 7 is applied.

[0019]

Such backlash preventing ribs 20, 21, 22 are, as shown in Fig. 3, formed by punching at the positions 20a, 21a, 22a in the proximity of the respective sides of the inner peripheral surface of the axial hole 4a of the reel 4 on the side to which a large force from the reel 4 is not applied by the use of a punch 23, so that a part of the reel 4 at the peripheral edge of the axial hole 4a is moved toward the torsion bar 7.

[0020]

In the seatbelt retractor 1 of such a structure shown in this example, when the locking mechanism 6 is actuated to lock rotation of the locking base 14 in the webbing unwinding direction CW in case of emergency or the like, a large force from the reel 4 is applied to the torsion bar 7 and a large force from the torsion bar 7 is applied to the locking base 14 as described above. At this time, in terms of the relation between the reel 4 and the torsion bar 7, a large force is directly transmitted from the reel 4 to the torsion bar 7 at the portion where the inner peripheral surface of the axial hole 4a of the reel and the outer peripheral surface of the first torque transmitting shaft 18 abut with respect to each other, but it is not transmitted from the reel 4 to the torsion bar 7 via the backlash preventing ribs 20, 21, 22. Therefore, a large force does

not act upon the backlash preventing ribs 20, 21, 22, and thus the backlash preventing ribs 20, 21, 22 are not susceptible to collapse when rotation in the webbing unwinding direction CW of the locking base 14 is locked by the activation of the locking mechanism 6.

[0021]

In the same manner, also in terms of the relation between the torsion bar 7 and the locking base 14, when rotation of the locking base 14 in the webbing unwinding direction CW is locked by the locking operation of the locking mechanism 6, a large force described above is directly transmitted from the torsion bar 7 to the locking base 14 at the portion where the inner periphery of the axial hole of the locking base 14 and the outer peripheral surface of the second torque transmitting shaft 17 abut with respect to each other, but it is not transmitted from the torsion bar 7 to the locking base 14 via the backlash preventing rib. Therefore, a large force does not act upon the backlash preventing rib formed on the inner peripheral surface of the axial hole of the locking base 14, and thus these backlash preventing ribs are not susceptible to collapse when rotation in the webbing unwinding direction CW of the locking base 14 is locked by the activation of locking mechanism 6.

[0022]

According to the seatbelt retractor 1 of this example, since the backlash preventing ribs for preventing backlash in a state in which the torsion bar 7 is press-fitted into the reel 4 and in a state in which the torsion bar 7 is press-fitted into the locking base 14 are provided at the position to which a large force generated when rotation of the locking base 14 in the webbing unwinding direction CW is locked is not applied, the collapse of the backlash preventing ribs caused by this force may be prevented. Therefore, occurrence of backlash between the torsion bar 7 and the reel 4, and between the torsion bar 7 and the locking base 14 caused by the collapse of the backlash preventing ribs can be prevented, thereby preventing squeak and rattle caused by backlash.

[0023]

The cross section of the backlash preventing rib may be, in addition to the arc-shaped cross section described above, other configurations such as the arc of the oval or the arc of the elongated circle in cross section as shown in Fig. 4(a), the triangular cross section as shown in (b) in the same figure, or the trapezoidal cross section, square cross section, or rectangular cross section as shown in (c) in the same figure. In addition, the configuration along the axis of the backlash preventing rib may have the constant width as shown in (d) in the same figure or the configuration with

axially continuously varying width as shown in (e) in the same figure.

[0024]

Instead of the backlash preventing rib, as shown in Fig. 5, a backlash preventing tapered portion 24 for guiding to displace the torsion bar 7 in the direction of rotation as described above may be provided on the inner peripheral surface of the axial hole on the reel 4 and on the locking base 14.

Alternatively, instead of providing the backlash preventing rib on the reel 4 and on the locking base 14, as shown in Fig. 6(a) and (b), the backlash preventing rib 25 may be provided on the first and the second torque transmitting shafts 18, 17 of the torsion bar 7.

In addition, the cross section of the axial hole on the reel 4 and on the locking base 14 and the cross section of the first and the second torque transmitting shafts 18, 17 are not limited to the hexagonal shape, but it may be any cross sectional configurations as far as the first and the second torque transmitting shafts 18, 17 can be rotatably fitted into the axial hole to connect them with each other.

[0025]

[Advantages]

As is apparent from the description above, in the seatbelt retractor of the present invention, since the

backlash preventing portion is provided on at least one of the first torque transmitting shaft and the second torque transmitting shaft, or at least one of the inner peripheral surfaces of the respective axial holes on the reel and on the locking member at the position to which a large force generated when rotation of the locking member in the webbing unwinding direction is locked is not applied, the collapse of the backlash preventing portion by such a force may be prevented. Therefore, it is ensured that occurrence of backlash at least one of the portion between the torsion bar and the reel, and between the torsion bar and the locking base is prevented by the collapse of the backlash preventing portion, and thus generation of squeak and rattle caused by backlash may also be prevented.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a cross sectional view showing an example of the embodiment of the seatbelt retractor according to the present invention.

[Fig. 2]

Fig. 2 is a drawing showing backlash preventing ribs of the seatbelt retractor in the example shown in Fig. 1.

[Fig. 3]

Fig. 3 is an explanatory drawing showing the formation of the backlash preventing rib shown in Fig. 2.

[Fig. 4]

Figs. 4(a) and (b) are drawings each showing an alternative example of the cross sectional configuration of the backlash preventing rib, and Figs. 4(d) and (e) are drawings each showing an example of the configuration of the backlash preventing rib along the axis.

[Fig. 5]

Fig. 5 is a drawing showing another example of the backlash preventing portion of the present invention.

[Fig. 6]

Fig. 6 shows other possible position of the backlash preventing rib of the present invention, wherein (a) is a partial front view, and (b) is a right side view of (a).

[Fig. 7]

Fig. 7 is an explanatory drawing showing backlash preventing ribs on the conventional seatbelt retractor.

[Reference Numerals]

1...seatbelt retractor, 2...frame, 3...webbing, 4...reel, 4a...axial hole, 5...deceleration sensing mechanism, 6...locking mechanism, 7...torsion bar, 8...spring means, 14...locking base, 17...second torque transmitting shaft, 18...first torque transmitting shaft, 20, 21, 22...backlash preventing rib, 23...punch, 24...backlash preventing tapered portion, 25...backlash preventing rib

[Name of Document] ABSTRACT

[Abstract]

[Object] To ensure prevention of occurrence of backlash between the torsion bar and a member to which the same is fitted even when a force is applied to the torsion bar when lock of the locking mechanism is effected.

[Solving Means] Three backlash preventing ribs 20, 21, 22 having arc-shaped cross section are provided on the inner peripheral surfaces of the axial hole 4a having hexagonal cross section of the reel 4 on the three sides $4a_1$, $4a_3$, $4a_5$, which are not adjacent with each other, respectively so as to extend in the axial direction. These backlash preventing ribs 20, 21, 22 are provided on the respective sides $4a_1$, $4a_3$, $4a_5$ on the sides to which a large force from the reel 4 is not applied. Therefore, since a large force generated when rotation of the locking base of the locking mechanism in the webbing unwinding direction is locked is not applied to these backlash preventing ribs 20, 21, 22, the collapse of the backlash preventing ribs 20, 21, 22 caused by such a force can be prevented. Therefore, occurrence of backlash caused by the collapse of the backlash preventing ribs 20, 21, 22 is prevented.

[Selected Figure] Fig. 2